

WHAT IS CLAIMED IS:

1. A system for separating and combining three spectrums of light, comprising:  
first, second, third and fourth polarizing beamsplitters, wherein each polarizing beamsplitter is configured to allow light having a first polarization orientation to pass therethrough, wherein each polarizing beamsplitter is configured to reflect light having a second polarization orientation, and wherein each polarizing beamsplitter has two interior sides adjacent two other polarizing beamsplitters, and two exterior sides that are not adjacent other polarizing beamsplitters; and  
a first retarder stack located adjacent an exterior side of the first polarizing beamsplitter;  
a second retarder stack located adjacent an interior side of the first polarizing beamsplitter; and  
a third retarder stack located between interior sides of two of the polarizing beamsplitters.
2. The system of claim 1, further comprising a fourth retarder stack located adjacent an exterior side of the fourth polarizing beamsplitter.
3. The system of claim 2, wherein the first and fourth retarder stacks have substantially similar characteristics.

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4. The system of claim 1, wherein the second and third retarder stacks have substantially similar characteristics.
5. The system of claim 1, further comprising first, second and third reflective modulator panels configured to selectively rotate the polarization orientation of reflected light in a spatial pattern.
6. The system of claim 5, wherein the first reflective modulator panel is located adjacent an exterior side of one of the polarizing beamsplitters.
7. The system of claim 6, wherein the second reflective modulator panel is located adjacent an exterior side of one of the polarizing beamsplitters.
8. The system of claim 7, wherein the third reflective modulator panel is located adjacent an exterior side of one of the polarizing beamsplitters that also has one of the first and second modulator panels adjacent its other exterior side.
9. The system of claim 5, further comprising first, second and third light doublers that are paired, respectively, with the first, second and third reflective modulator panels.

10. The system of claim 1, further comprising an input polarizer, located adjacent the first retarder stack, for polarizing input light.

11. The system of claim 1, wherein the first retarder stack is configured to receive polarized input light and to output a first spectrum in the first polarization orientation and a second spectrum in the second polarization orientation.

12. The system of claim 11, wherein the first polarizing beamsplitter is arranged to receive the light output from the first retarder stack in a first direction, and wherein the first polarizing beamsplitter is configured to allow light in the first spectrum, having the first polarization orientation, to pass therethrough in the first direction, and to reflect light in the second spectrum, having the second polarization orientation, in a second direction towards the third polarizing beamsplitter.

13. The system of claim 12, wherein the second polarizing beamsplitter is arranged to receive the light in the first spectrum, passing through the first polarizing beamsplitter in the first direction, and wherein the second polarizing beamsplitter is configured to reflect light having the second polarization orientation, and passing in a third direction that is opposite to the first direction, in the second direction towards the fourth polarizing beamsplitter.

14. The system of claim 13, further comprising a reflective modulator panel arranged on an exterior side of the second polarizing beamsplitter, wherein the first reflective modulator panel is configured to reflect incident light passing in the first direction so that it leaves the modulator panel in the third direction, and to selectively modulate the polarization orientation of the reflected light in a spatial pattern.

15. The system of claim 13, wherein the second retarder stack is arranged to receive the light in the second spectrum, having the second polarization orientation, that is reflected by the first polarizing beamsplitter, wherein the second retarder stack is configured to allow a third spectrum of the light to pass therethrough without a change in its polarization orientation, and wherein the second retarder stack is configured to change the polarization orientation of a fourth spectrum back to the first polarization orientation.

16. The system of claim 15, wherein the third polarizing beamsplitter is configured to reflect light passing in the second direction and having the second polarization orientation so that it travels in the third direction, wherein the third polarizing beamsplitter is configured to reflect light passing in a fourth direction, opposite to the second direction, so that it travels in the first direction towards the fourth polarizing beamsplitter, and wherein the third polarizing beamsplitter is configured to

allow light having the first polarization orientation to pass therethrough without deflection.

17. The system of claim 16, further comprising a first reflective modulator panel arranged on an exterior side of the third polarizing beamsplitter opposite the first polarizing beamsplitter, and a second reflective modulator panel arranged on an exterior side of the third polarizing beamsplitter opposite the fourth polarizing beamsplitter, wherein the first reflective modulator panel is configured to reflect incident light passing in the second direction so that it leaves the first reflective modulator panel in the fourth direction, and to selectively modulate the polarization orientation of the reflected light in a spatial pattern, and wherein the second reflective modulator panel is configured to reflect incident light passing in the third direction so that it leaves the second reflective modulator panel in the first direction, and to selectively modulate the polarization orientation of the reflected light in a spatial pattern.

18. The system of claim 16, wherein the third retarder stack is arranged to receive light passing from the third polarizing beamsplitter towards the fourth polarizing beamsplitter, wherein the third retarder stack is configured to allow light in the third spectrum, having the first polarization orientation, to pass therethrough without a change in its polarization orientation, and wherein the third retarder stack is configured to

change the polarization orientation of the light in the fourth spectrum from the second polarization orientation to the first polarization orientation.

19. The system of claim 18, wherein the fourth polarizing beamsplitter is configured to allow the light in the third and fourth spectrums to pass therethrough without deflection, and wherein the fourth polarizing beamsplitter is configured to reflect light in the first spectrum passing in the second direction, and having the second polarization orientation.

20. The system of claim 19, further comprising a fourth retarder stack arranged adjacent an exterior side of the fourth polarizing beamsplitter and arranged to receive light in the first, third and fourth spectrums passing from the fourth polarizing beamsplitter, wherein the fourth retarder stack is configured to allow light in the third and fourth spectrums to pass therethrough without a change in their polarization orientation, and wherein the fourth retarder stack is configured to change the polarization orientation of light in the first spectrum from the second polarization orientation to the first polarization orientation.

21. The system of claim 1, wherein at least one of the first, second and third retarder stacks reflects or blocks selected wavelengths of light.

22. The system of claim 21, wherein the reflected or blocked wavelengths of light are located substantially between the first and third spectrums of light.

23. The system of claim 21, wherein the reflected or blocked wavelengths of light are located substantially between the third and fourth spectrums of light.

24. A color projection system, comprising:

first, second, third and fourth polarizing beamsplitters, arranged in a square pattern, wherein each polarizing beamsplitter is configured to allow light having a first polarization orientation to pass therethrough, wherein each polarizing beamsplitter is configured to reflect light having a second polarization orientation, and wherein each polarizing beamsplitter has two interior sides adjacent two other polarizing beamsplitters, and two exterior sides that are not adjacent other polarizing beamsplitters;

a first retarder stack located on an exterior side of the first polarizing beamsplitter;

a second retarder stack located adjacent an interior side of the first polarizing beamsplitter;

a third retarder stack located between interior sides of two of the polarizing beamsplitters;

a light source located adjacent the first retarder stack; and

projection optics located adjacent the fourth polarizing beamsplitter.

25. The system of claim 24, further comprising a fourth retarder stack located adjacent an exterior side of the fourth polarizing beamsplitter.

26. The system of claim 24, further comprising first, second and third reflective modulator panels configured to selectively rotate the polarization orientation of reflected light in a spatial pattern.

27. The system of claim 26, wherein the system is configured so that substantially equal distances exist between the projection optics and each of the first, second and third modulator panels.

28. The system of claim 26, wherein the first reflective modulator panel is located adjacent an exterior side of one polarizing beamsplitter, and wherein the second and third reflective modulator panels are located adjacent exterior sides of another of the polarizing beamsplitters.



29. The system of claim 26, further comprising first, second and third light doublers that are paired, respectively, with the first, second and third reflective modulator panels.

30. A system for separating and combining three spectrums of light, comprising:  
a polarizing beamsplitter;  
an input retarder stack located adjacent a first side of the polarizing beamsplitter;  
a spacer located adjacent a second side of the polarizing beamsplitter; and  
a dichroic beamsplitter located adjacent a third side of the polarizing beamsplitter.

31. The system of claim 30, further comprising an output retarder stack located adjacent a fourth side of the polarizing beamsplitter.

32. The system of claim 31, wherein the input and output retarder stacks have substantially similar characteristics.

33. The system of claim 30, further comprising first, second and third reflective modulator panels configured to selectively rotate the polarization orientation of reflected light in a spatial pattern.

34. The system of claim 33, wherein the first reflective modulator panel is located adjacent a side of the spacer opposite the polarizing beamsplitter, wherein the second reflective modulator panel is located adjacent a first exterior side of the dichroic beamsplitter, and wherein the third reflective modulator panel is located adjacent a second exterior side of the dichroic beamsplitter.

35. The system of claim 34, further comprising first, second and third light doublers that are paired, respectively, with the first, second and third reflective modulator panels.

36. The system of claim 34, further comprising first and second light doublers, wherein the first light doubler operates on light modulated by the first reflective modulator panel, and wherein the second light doubler operates on light modulated by the second and third modulator panels.

37. The system of claim 36, wherein the first light doubler is located between the polarizing beamsplitter and the spacer.

38. The system of claim 36, wherein the first light doubler is located between the spacer and the first reflective modulator panel.

39. The system of claim 36, wherein the second light doubler is located between the polarizing beamsplitter and the dichroic beamsplitter.

40. The system of claim 30, further comprising an input polarizer, located adjacent the input retarder stack, for polarizing input light.

41. The system of claim 30, further comprising a polarization conversion system, located adjacent the input retarder stack for polarizing input light.

42. The system of claim 41, further comprising a clean-up polarizer located between the polarization conversion system and the input retarder stack.

43. The system of claim 30, wherein the first retarder stack is configured to receive polarized input light passing in a first direction, and to output a first spectrum of

light in a first polarization orientation and a second spectrum of light in a second polarization orientation.

44. The system of claim 43, wherein the polarizing beamsplitter is configured direct light having the first polarization orientation that is received from the input retarder stack towards the spacer, wherein the polarizing beamsplitter is configured to direct any light having the second polarization orientation that is received from the input retarder stack towards the dichroic beamsplitter, wherein the polarizing beamsplitter is configured to direct any light having the second polarization orientation that is received from the spacer towards a fourth side of the polarizing beamsplitter, and wherein the polarizing beamsplitter is configured to direct any light having the first polarization orientation that is received from the dichroic beamsplitter towards the fourth side of the polarizing beamsplitter.

45. The system of claim 44, wherein the dichroic beamsplitter is configured to receive the light in the second spectrum, having the second polarization orientation, from the polarizing beamsplitter, to direct a third spectrum of the received light toward a first exterior side of the dichroic beamsplitter and to direct a fourth spectrum of the received light toward a second exterior side of the dichroic beamsplitter, wherein the dichroic beamsplitter is configured to direct any light in the third spectrum returned from the first

exterior side towards the polarizing beamsplitter, and wherein the dichroic beamsplitter is configured to direct any light in the fourth spectrum returned from the second exterior side towards the polarizing beamsplitter.

46. The system of claim 45, further comprising a first reflective modulator panel located adjacent the first exterior side of the dichroic beamsplitter, and a second reflective modulator panel located adjacent the second exterior side of the dichroic beamsplitter, wherein the first reflective modulator panel is configured to reflect and selectively modulate light in the third spectrum, and wherein the second reflective modulator panel is configured to reflect and selectively modulate light in the fourth spectrum.

47. The system of claim 46, further comprising a third reflective modulator panel, located adjacent an exterior side of the spacer opposite the polarizing beamsplitter, wherein the third reflective modulator panel is configured to reflect and selectively modulate light in the first spectrum.

48. A color projection system, comprising:  
a polarizing beamsplitter;  
an input retarder stack located adjacent a first side of the polarizing beamsplitter;

a light source located adjacent the first retarder stack;  
a spacer located adjacent a second side of the polarizing beamsplitter;  
a dichroic beamsplitter located adjacent a second side of the polarizing  
beamsplitter; and  
projection optics located adjacent a third side of the polarizing beamsplitter.

49. The system of claim 48, further comprising first, second and third reflective modulator panels configured to selectively rotate the polarization orientation of reflected light in a spatial pattern.

50. The system of claim 49, wherein the first reflective modulator panel is located adjacent a side of the spacer opposite the polarizing beamsplitter, wherein the second reflective modulator panel is located adjacent a first side of the dichroic beamsplitter, and wherein the third reflective modulator panel is located adjacent a second side of the dichroic beamsplitter.

51. The system of claim 50, further comprising first, second and third light doublers that are paired, respectively, with the first, second and third reflective modulator panels.

52. The system of claim 50, further comprising first and second light doublers, wherein the first light doubler operates on light modulated by the first reflective modulator panel, and wherein the second light doubler operates on light modulated by the second and third reflective modulator panels.

53. The system of claim 48, further comprising an output retarder stack located adjacent a fourth side of the polarizing beamsplitter.

54. The system of claim 53, wherein the output retarder stack is configured to ensure that the polarization orientation of light in the first, third and fourth spectrums is the same.

55. A method of separating, modulating and re-combining spectrums of light, comprising the steps of:

conditioning input light with a first retarder stack so that input light in a first spectrum has a first polarization orientation, and input light in a second spectrum has a second polarization orientation;

separating the light in the first spectrum from the light in the second spectrum using a polarizing beamsplitter;

conditioning the separated light in the second spectrum using a second retarder stack so that light in a third spectrum has the first polarization orientation, and light in a fourth spectrum has the second polarization orientation;

separating the light in the third spectrum from the light in the fourth spectrum using a polarizing beamsplitter;

modulating light in the first, third and fourth spectrums separately, using first, second and third modulators; and

recombining the first, third and fourth modulated spectrums of light.

56. A method of separating, modulating, and re-combining spectrums of light, comprising the steps of:

conditioning input light with a first retarder stack so that input light in a first spectrum has a first polarization orientation, and input light in a second spectrum has a second polarization orientation;

separating the light in the first spectrum from the light in the second spectrum using a polarizing beamsplitter;

separating light in the separated second spectrum into third and fourth spectrums of light with a dichroic beamsplitter;

modulating the light in the first, third and fourth spectrums separately, using first, second and third modulators; and



recombining the first, third and fourth modulated spectrums of light.

57. A system for separating input light into multiple spectra, comprising:

first, second, third and fourth polarizing beamsplitters, wherein each polarizing beamsplitter is configured to allow light having a first polarization orientation to pass therehrough, and wherein each polarizing beamsplitter is configured to reflect light having a second polarization orientation; and

first, second and third retarder stacks, wherein the first, second, third and fourth polarizing beamsplitters and the first, second and third retarder stacks are arranged and optically coupled such that said input light is separated into said multiple spectra.

58. A system for separating and combining multiple spectra of light, comprising:

a polarizing beamsplitter;

an input retarder stack located adjacent a first side of the polarizing beamsplitter; and

a dichroic beamsplitter located adjacent a second side of the polarizing beamsplitter.

59. A system for combining multiple input spectra, comprising:

first, second, third and fourth polarizing beamsplitters, wherein each polarizing beamsplitter is configured to allow light having a first polarization orientation to pass therehrough, and wherein each polarizing beamsplitter is configured to reflect light having a second polarization orientation; and

first, second and third retarder stacks, wherein the first, second, third and fourth polarizing beamsplitters and the first, second and third retarder stacks are arranged and optically coupled such that said multiple input spectra are combined.